SOUTH AUSTRALIA.

GOVERNMENT GEOLOGIST'S REPORT RE VISIT TO FAR NORTH.

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Government Geologist's Office, Adelaide, August 15th, 1884.

Sir—I have the honor to forward herewith the accompanying preliminary report on the route passed over by me during my last two journeys, from 2nd to 27th May, and from 9th June to 5th August, during which time, with the exception of about ten days, when I visited Ironstone Lagoon, some distance to the north-west of Port Augusta, on the Coondambo road, to report on a site for well-boring, I have been engaged in an examination of the geology of the country to the east and west of Farina with the object of eventually constructing a geological and mineralogical map of the whole district. The route of the first journey was from Farina *viâ* Witchelina, westward to Hedley's Hill, near the head of Lake Torrens, thence *viâ* Mount Nor'-West and Termination Hill to Leigh's Creek. That of the second was from the latter place *viâ* Mount Coffin and Fink's Springs to Mount Serle, Umberatana, Yudnamutana, Mount Freeling, Duck-ponds, Petermorra, Parallana, and Wooltana, thence *viâ* Bolla Bollana and Mount Lyndhurst to Farina.

I have, &c.,

HENRY Y. L. BROWN, Government Geologist.

To the Honorable the Commissioner of Crown Lands and Immigration.

REPORT ON THE COUNTRY EAST AND WEST OF FARINA.

Farina.

Low undulating plains, covered in places with semi-angular quartz and quartzites, with table-hills of desert quartzite, conglomerate and gravel beds resting on quartzites and slates, which are covered in places by tertiary and cretaceous sand and clay deposits. The older rocks are traversed here and there by numerous veins of quartz and iron ore. Eastward of the railway the bed rock dips beneath the plain, re-appearing only at intervals in isolated hills and ridges, trending northwards towards Mundowadna and Hergott Springs; at the latter place a recent bore has proved it to be overlaid by more than 300ft. of cretaceous strata.

From Farina to Witchelina are wide creek flats and stony downs, with low table-hills and white escarpments consisting of kaolinized slates and quartzites. The bed rock, namely, quartzose sandstone, with quartz veins, clay, flinty and calcareous slates, with quartz, iron ore veins, and flinty siliceous dykes, are here also often capped with a thin layer of gravel and boulder drift.

Witchelina. Cleaved and jointed calcareous clay, slates, and flags strike N.N.E.; siliceous limestone and limestone strike N.N.W., dip W. 70°.

Witchelina well is sunk in calcareous flags, clayslates, and limestones to a depth of 90ft., and yields a large supply of fresh water.

Southward of Witchelina some six miles there are alternating ridgy outcrops of blue limestone, quartzite, and cream-colored oolitic dolomitic marble—a highly ornamental rock. The bearing of these strata varies from N.N.E. and N.W. to E. and W., and they contain veins of flinty quartzite, ironstone, and quartz.

The rocks of this range are a southerly continuation of those forming the Mount Nor'-West range, which have been alluded to in a previous report. On the western flanks of Mount Nor'-West the strata form low synclinals and anticlinals of quartzose sandstone and quartzite, calcareous grit and sandstone and calcareous slates, flags and limestones, traversed by calc spar and ferro calcite veins. Other portions of the ranges consist of argillaceous grit and conglomerate, quartose grit, quartzite, kaolinized slates and sandy shales. The conglomerate, besides pebbles of quartz, flint, lydianstone, and siliceous pebbles of all kinds, contains large boulders of quartz rock and quartzite two or three feet in diameter. The plains and wide creek flats bordering the ranges often show outcrops of slaty rocks, with or without quartz or ironstone veins, chiefly of kaolinized slates; it is probable that much of the soft yellow loamy clay covering these plains is derived from the denudation of these decomposed slates and shales.

Westward of the range are sandhills, plains, and flats which extend towards Lake Torrens, covering a basin of tertiary and cretaceous rocks with their characteristic scarped table-hills capped with desert quartzite (cellular and solid), flint, chalcedonic quartz, red and striped jaspar and conglomerate, in stalactitic and nodular forms, resting on gypseous clays and marls.

A boulder and gravel drift often underlies the desert quartzite and sandstone here.

Termination Hill, 1,400ft. above the sea. A section of the strata shows it to consist of quartzite and calcareous boulder conglomerate (comprising quartzite, quartz rock, cherty flint, granite, porphyry and limestone, many of the boulders being of considerable size) interstratified with clay slates, limestones and calcareous slates, quartzose sandstones, and kaolinized slates resting on a great thickness of quartzite and flaggy quartzose sandstone, often ripple marked. Here there can be seen a remarkable twisting round of the strata, which a little north of Termination Hill trig. changes in strike and bends round at an angle considerably less than a right angle, the turn in the beds being clearly visible from the summit of the hill. Veins of yellow flint, chert, oolitic limestone, and calcareous quartzite traverse these rocks. Between these ranges and Farina there is a wide plain, in some places showing outcrops of the usual bed rocks, which afterwards disappear beneath a basin of tertiary sand and clay, which extends down the valley of Leigh's Creek.

Southwards

Southwards towards Myrtle Springs and Leigh's Creek railway station, the older rocks, where examined, are very similar to those forming the Mount Nor'-West and Termination Ranges, and show similar sudden changes in strike. Tertiary boulder drift with low escarpments, red sand ridges, and gypseous clays occupy the flat country which is generally covered with stones denuded from the low protrusions of bed rock, which appear frequently from beneath the younger deposits.

Myrtle Springs (Old Station).—Blue massive limestone, flags and calcareous grit and quartzites, occur here, and with calcareous flags, slates and limestone form the bed rock to within a short distance of Leigh's Creek railway station.

Cutaway Hills, Leigh's Creek.—Here beds of flaggy sandstone and quartz conglomerate overlie unconformably clay slates and sandstones with veins of ironstone. Having tried the surface for gold I obtained several specks of that metal; the locality is worth prospecting, as also are several places along the railway line between Leigh's Creek and Farina.

Aroona, 1,400 feet above the sea.—The rocks composing this hill and the range generally are a continuation of those to the northward, from Termination Hill and Mount Nor'-West, with the addition of beds of massive red crystalline limestone underlying the quartzite.

Two miles south-east of Leigh's Creek railway station there are some old workings from which copper ore has been obtained. Green carbonate exists in small veins, coloring a white argillaceous sandstone, with which reefs of iron ore and siliceous rocks are associated. Greenstone dykes, calc spar, ferro calcite, and quartz veins also occur.

Leigh's Creek to Mount Coffin Mine.

Leigh's Creek (Head Station).—Calcareous flags and slates and limestone form low synclinals in this neighborhood, with quartz and flinty lodes and iron ore.

Mount Coffin Mine.—Copper ore consisting of oxide, carbonate, &c., interbedded with jointed feldspathic quartzose claystone, siliceous limestone and calcareous slates, having a bearing of W. 10° N. (magnetic), and dipping 60° to 70° south, with flat leaders of small size, but containing good ore, crossing more or less at right angles to the dip of the strata, has here been worked to a depth of about 100ft.; at present only two miners are engaged in raising ore from the old workings, which might be advantageously prospected at a deeper level.

Mount Coffin, 1,657 feet above the sea.—Flinty quartzite, partly a veinstone, and micaceous sandstone and quartzite form the hill itself, with cleaved clayslates and kaolinized shales below. Veins of iron ore and flinty ferruginous lodes occur in the neighborhood. An outcrop of old boulder conglomerate is interbedded with the slates in which copper stains are visible for some distance eastward of Mount Coffin.

Leigh's Creek Mine.—A deserted mine some three miles east of Mount Coffin. A considerable amount of work has been done here in prospecting and working a lode of calc spar and ferro calcite, traversing calcareous slates and flags and argillaceous sandstone. The mine having been abandoned I had no opportunity of inspecting the workings.

Fink's Springs are at the outlet of a creek running at right angles to the strike of vertical and highly inclined quartzites and slates, from fissures in which the water issues in a small stream. A deposit of calcareous tufa has been deposited by the water and formed a conglomerate with the pebbles and boulders of the creek. This kind of deposit is found almost invariably in the neighborhood of rock springs in this region, and also at many places where springs do not now exist, having probably become extinct through the closing up of the outlets by the deposit. In such places water is very likely to be obtained by sinking.

The range immediately to the south of Patsey's and Fink's Springs is almost entirely composed of vertical beds of quartzite and sandstone, with alternations of slaty rocks rising to a considerable elevation above the adjoining softer clay and calcareous slate country.

Mount Serle District.

Coonapolkina.—About one and half miles east of Stuart's Waterholes, Messrs. Marsh and Milte have lately discovered, near the junction of the slate and quartzites, a load of rich galena and carbonate of lead, which has a promising appearance as far as prospected about two or three feet below the surface.

At three or four other localities, between Fink's Springs and Frome Well, they have also discovered galena and carbonate of lead lodes in the clay and calcareous slaty shale, the lode formation being calc spar and ferro calcite, with sometimes quartz and ferruginous gossan; these lodes also are worth further prospecting.

The following are assays of the ores procured by myself from these claims, made by Mr. G. Goyder, jun.:—

	Lead.	Silver.
Cerussite or carbonate of lead, from 1½ miles east of Stuart's waterholes gave, per ton	58·5 per cent.	3 ozs. 9 dwts.
Galenite or sulphide of lead from the same locality	65·4 per cent.	1 oz. 3 dwts.
Galenite from No. 2 claim 1¾ miles west of Frome Well	70 per cent.	8 ozs. 10 dwts.
Cerussite from their most westerly claim	70 per cent.	7 ozs. 4 dwts.

In this neighborhood there are several strong lodes of iron ore and flinty quartzite and dolomitic limestone, running in a north-westerly direction for considerable distances, which, as mentioned in a previous report, are likely to be found to contain metalliferous deposits along some portion of their course.

Mount Serle, 3,000 feet above the sea.—Noah's Ark and other hills in this vicinity are not connected with the main ranges; they are chiefly composed of beds of quartzite and quartzose sandstone, with the usual slaty shale partings underlaid by greenish flaggy slates, generally calcareous.

The same formation extends over a great portion of the country northwards.

Arcoona Bluff, 2,850ft. above the sea.—Flaggy quartzites with thin bands of slaty shale underlaid by clay slates and calcareous shales and flaggy limestones.

At Umberatana.—Clay slates with a little quartz striped limestones and calcareous slates, quartzite and sandstones.

Near Burt's Hill trig., four miles east of Umberatana, a change takes places, the rocks becoming more micaceous and crystalline and hornblendic, indicating the presence of igneous dykes not far beneath the surface; there are also frequent changes in the strike of the rocks, which consist of boulder conglomerate, spotted mica schist, crystalline limestone, calcareous slates and shales.

Yudnamutana and adjoining ranges.

The higher portions of the mountainous country here is chiefly composed of rough, jagged, peaked hills of quartzite, quartz rock and sandstone, with massive lodes of flinty quartzite, iron ore, and quartz traversing them in various directions, the whole being deeply cut into by creeks and gullies; while the lower parts consist

consist of calcareous shale, quartzites, limestones, and sandstone, with masses of metamorphic and hornblendic and actinolite rock, greenstone, hornblende and mica schist and also with flinty quartzite, micaccous iron, hæmatite and limestone lodes. Some of the quartzite rock contains boulders and pebbles of a still older quartzite. The flinty quartzite lodes are stained in many places with green carbonate of copper.

Gold is worked to a small extent in the alluvial detritus in a gully and creek near the old Yudnamutana mine, two men being employed at the time of my visit. The gold has not been traced far from the steep ground where it originates; it will very likely, however, be found in the main creek lower down where there is an opportunity of sinking in alluvial, free from the boulders, which in these regions fill up the watercourses.

The copper mines here have been abandoned; to all appearances they have never been prospected to any great extent as regards depth.

Yudnamutana to Daly and Stanley mines.—Metamorphic clay and micaccous and hornblendic slates, vertical and highly inclined, calcareous flags and slates and limestone, with reefs and veins of quartz and flinty rock, and occasional calcareous veins.

Daly Bluff is a jagged mass of quartzite and grit conglomerate, stained in part with green carbonate of copper and penetrated by siliceous veins. Outcrops of the same kind are common in the vicinity, forming peaks and serrated ridges of considerable elevation.

The Daly and Stanley mines have been deserted for some years; they, as well as the Yudnamutana and other mines, were examined some years ago by Professor Ulrich, F.G.S., &c., and described in his valuable report on "Mines north of Port Augusta."

Not far from the Daly mine there is a well defined lode of gossan and rich copper ore, in hornblende rock and siliceous limestone, which has only been prospected to a depth of three or four feet.

Near the Stanley mine, the clayslate contains, boulders of quartzite, granite, &c., of large size scattered through it.

Daly Bluff to Freeling Heights.—Alternations of mica slates and schists, pebble granite conglomerate, cherty and ferruginous rocks, pyroxene, hornblende, and actinolite, with dykes of greenstone.

Freeling Heights, 3,130ft., are quartzite, micaceous quartzite and sandstone, with a few quartz veins.

Daly Bluff *viâ* Tindelpana Well, Freeling, Duckponds, and Freeling Water to Petermorra.—Clay slates, calcareous slates, limestones and flags, sandstones and boulder conglomerate, are met with in anticlinal and synclinal basins, and long lines of outcrop all along the route.

Quartz and quartzite lodes of large size, with ferro calcite and calcite and dolomitic limestone; white quartz and ironstone veins are frequent near Tindelpana Well, the Twins, Freeling, Freeling Water, &c. Many of these places, particularly the last named, being favorable localities for gold prospecting.

At the Duckponds the upturned edges of the bed rock are capped with a layer of the tertiary boulder drift and gravel, which is generally found near where the ranges dip beneath the plains. The deeper parts of this deposit would be likely to contain gold, should it be found to exist in the district.

Catt's Springs are on the plain bordering the end of the main range, some three miles westward of Petermorra; they rise through horizontal limestone conglomerate, sandstone and ferruginous sandstone, and would doubtless yield a large supply of water if opened up.

Petermorra Springs extend for a mile or more along a creek following the boundary of the range and the plain; the water here also rises through horizontal strata similar to those at Catt's Springs The temperature of one of these proved to be 74° F., while that of ordinary surface water was 54°. A slight taste of sulphuretted hydrogen is perceptible, otherwise the water is fresh enough for any purpose.

The hills in this locality are of a different formation to those further westward. Granite enclosing pebbles and boulders of granite, syenite, quartzite, quartz, chert and opalline quartz is a common rock; quartzite and quartz rock and white glassy quartz reefs occur in it, and the micaceous granite, gneissic granite mica schist which compose the range.

Prospect Hill trig.—Quartzite and siliceous pebble conglomerate with quartz veins.

Gneissic micaceous granite and coarse granite, with large rounded feldspar crystals and half obliterated granite boulders and pebbles with mica schist constitute the bed rock to Mount Babbage, and round the north end of the range.

Mount Babbage and the hills adjoining it are composed of coarse feldspathic granite, gneissic granite, and micaceous schist, into which are intruded dykes of coarse and fine feldspar and quartz and fine-grained granite, capped by beds of quartzite grit and conglomerate at various levels from that of near the plain, to over 700ft. above it in the case of Mount Babbage itself. This formation overlies the cretaceous clays and marls of the plains, and is probably of the same age as the desert quartzite.

Twelve Springs are situated on the plain, some four miles north of Mount Babbage at the head of the Yerila Creek. Some are isolated at long distances apart, while as many as twenty may be counted in a space of 100 × 150 yards; the supply is large and the water good. In the case of all these springs and others which belong to the tertiary and cretaceous formation, the supply may be enormously increased and the quality of the water improved by opening them up by sinking wells or bores.

Northward of Twelve Springs there are several flat-topped hills of desert quartzite and conglomerate capping gypseous clay and marls rising to about 250ft. above the level of the plain, and surrounded by stony downs and vast plains, stretching towards the sandhills and stony deserts of Strzelecki and Cooper's Creek and Diamentina River.

Parallana Hill.—Gneissic pink and red metamorphic granite, partially stratified with siliceous lodes and mica schist bands and coarse feldspar veins; dykes and masses of dense greenstone trap, porphyritic syenite, granite with hornblendic feldspathic rocks and epidote. Pieces of copper ore were obtained here in the watercourses.

Southward the ranges, where examined, expose red and green porphyry, granite, syenite, and greenstone, with pink granulite—the latter being the prevailing rock.

Mount Adams.—An inlying patch of metamorphic clay slate and sandstones in undulating and contorted beds are imposed between the plain and Mount Adams; greenstone, feldspar, and quartz dykes, and quartzite reefs marking the junction between them and the granite. A boulder containing copper ore was found here lying on the slate rock.

Parallana Hot Springs lies about three miles from Parallana Head Station in a northerly direction. The water, which has a temperature of 140° F., is evolved in considerable quantities from beneath three or four large boulders of red and yellow jaspery and chalcedonic quartz, which are portions of a lode or reef which crosses the watercourse at that point. The adjoining rocks are yellow and red gneissic granite, syenite, quartzite, and mica schist; these chalcedonic and jaspery quartz veins have been, partially at any rate, deposited by hot water containing silica in solution. This spring is therefore probably a relic of a series of hot springs

springs, which in ancient times played an important part in metamorphising sandstones into quartzites and filling up fissures which are now marked by the numerous siliceous lodes and veins which traverse the rocks so extensively.

The ranges near Parallana are very steep, precipitous, and rugged, rising to a height of over 3,000ft. above sea level.

Parallana to Wooltana.—Near the Arkaroola Creek an amygdaloidal, igneous rock, not previously noticed, takes the place of the granite; it is associated with metamorphic sandstone, dense greenstone trap, hornblendic and serpentinous rocks. Large siliceous reefs, veins of red jasper, quartz, micaceous iron, calc spar, and ferro calcite are common in it; with these promising-looking lodes of copper ore occur.

Woodloomooka, a copper locality.—Masses of siliceous lodestone running north-easterly with cross veins of the same rock in amygdaloid, alongside which a lode of copper ore has been traced for some distance and prospected by holes from 10ft. to 15ft. deep on a lode formation 3ft. or 4ft. thick, in which rich veins of copper glance have been exposed. At a distance for about two miles northward, several shallow pits have been sunk where there were indications of copper in connection with siliceous dykes radiating in many directions. In one of these, at a depth of 8ft or 10ft., in a well-defined lode formation, a vein of rich copper ore is exposed which is worth sinking on. One advantage these localities have, is that they are on the edge of the ranges, and within about half a mile of a main road to Hawker. Altogether the north-eastern portion of the range is a promising one for prospectors, who have here the advantage of operating over a larger area occupied by metamorphic and igneous rocks than elsewhere on this range.

Asbestus crops out on the surface of the amygdaloid in one or two places, and might be prospected with advantage, as the mineral is of value when found of good quality and in sufficient quantity.

Eastward to the boundary of New South Wales is a vast tertiary covered plain, the nearest points at which the bed rock comes to the surface as far as at present known, being the Mount Brown and Mount Arrowsmith ranges; the latter being partly composed of an amygdaloidal trap rock similar to that at Wooltana.

Mount Jacob.—The base of the range whereof Mount Jacob is the summit, is formed of amygdaloid rock with bands of hard metamorphic sandstone, with quartz veins and calc spar; off this dip beds of limestone, grit, gravel and boulder conglomerate, quartzite, &c. (with limestone, quartz, and ferruginous reefs containing copper ore), crystalline limestone, and conglomerate, massive boulder conglomerate, sandstone, quartzite and shales, and boulder conglomerate. Westward the usual lines of outcrop of the slate and calcareous and quartzose strata, can be seen curving round the hills. The boulders and pebbles which constitute this conglomerate vary in size from small pebbles up to a diameter of four or five feet, the matrix they are embedded in also varies from hard limestone and quartzite to a sandy shale and clay slate.

In travelling from Wooltana to Bolla Bollana and Umberatana, the strata passed over are continuations and repetitions of those already mentioned from Umberatana *viâ* Yudnamutana round the end of the range. Amygdaloidal igneous rocks, conglomerate and claystone, clay and calcareous slates, limestone and quartzite sandstone, calcareous slates and siliceous limestone, quartz, quartzite, ferruginous, and calcareous veins and lodes are frequent. This pass through the mountains is very rough, steep and stony in places, the quartzites and massive limestones being tilted up at high angles.

East and west of Bolla Bollana metamorphic rocks, chloritic, micaceous and hornblendic, indicate their presence by the occurrence of boulders in the creeks, as also do greenstone dykes. Betwen this place and Umberatana, the strata from an E. and W. bearing change to N. and N.W., and several large lode outcrops of quartz rock and quartzite occur.

Umberatana to Mount Lyndhurst Station and Farina.—Kaolinized and undecomposed slates, flags, and limestones with undulating and highly inclined dips, highly cleaved and jointed, the hard flaggy portions of the beds standing up more or less perpendicularly in serrated outcrops, the stratification being marked only by the different colored bands of rock. Belts of quartz, calc spar, ferro calcite, and ironstone reefs occur at intervals, also quartzite lodes; the country generally being flat and undulating, dipping northwards under the tertiary and cretaceous plains. The surface is covered in many places with quartz detritus. About three miles westward of Lesley's Well the bed-rock disappears beneath the plains of the Munday Creek, being bounded by low scarpments of tertiary gravel and boulder conglomerate, reappearing, however, within a few miles of Farina, where a belt of quartz reef and ferruginous veins accompany them.

Hergott Springs also belong to the class of mound springs of the cretaceous formation, which vary little in character and appearance wherever they occur. Here, as noted elsewhere, the water is of various qualities, even in springs a short distance apart; this is most probably caused by the comparatively pure water from the drifts overlying the bed rock absorbing salts of various kinds on its passage through the horizontal strata to the surface; in some cases doubtless where the pressure is considerable it forces its way directly upwards through fissures, while in others it may accumulate and filter slowly through the gypseous and salt-bearing strata, absorbing whatever impurity it comes in contact with. The bore sunk recently near these springs passed some distance into the bed rock before meeting water; an examination of the core shews that the gravel mixed with clay overlying the bed rock must contain too much of the latter to render it pervious to water. The bed rock in which the water was met with contains fissures through which the water from the overlying or adjacent drifts is conducted to the bore.

Chief localities of metallic minerals alluded to in this report:—

Gold.

Yudnamutana and Cutaway Hills, Leigh Creek.

Copper.

Leigh Creek, Mount Coffin, Leigh Creek mine, Owieandana, Yudnamutana, Daly and Stanley mines, and neighbourhood, Duckponds, Parabarama, Wooltana and Mount Adams.

Lead.

Mount Serle, near Stuart's Waterholes, and between Mount Serle and Fink's Springs.

There are many likely gold localities for prospecting, as follows:—

In neighborhood of Farina and between that place and Leigh Creek, near Lesley's Well, Freeling, Freeling Water, near Catt's Springs, Twins Trig., Mount Serle, Umberatana, Mount Lyndhurst, Fink's and Patsey's Springs, &c.

In prospecting it is advisable to search the softer strata forming the lower ranges, rather than the steep and rocky gorges, as more likely to lead to satisfactory results.

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Government Geologist's Office, Adelaide, August 15th, 1884.